

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
 Washington, DC 20554

FCC 95-41

In the matter of	)	
	)	
Amendment of Part 90 of the	)	PR Docket No. 93-61
Commission's Rules to Adopt	)	
Regulations for Automatic	)	
Vehicle Monitoring Systems	)	

### REPORT AND ORDER

Adopted: February 3, 1995

Released: February 6, 1995

By the Commission: Commissioner Quello concurring and issuing a statement;  
 Commissioner Barrett dissenting and issuing a statement; Commissioners Ness and Chong  
 issuing separate statements.

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## I. INTRODUCTION

1. In this Report and Order, we adopt rules for the future licensing and continued development of a number of services and equipment using the 902-928 MHz band. In recent years, Automatic Vehicle Monitoring (AVM) systems and unlicensed Part 15 devices have developed and proliferated in this band and are providing services that are valuable and in the public interest. These services range from licensed vehicle location and automatic toll collection systems to unlicensed devices used for utility meter reading and inventory control. Our allocation plan for the 902-928 MHz band includes 8 MHz of additional spectrum for AVM services and establishes new provisions for governing the interference obligations of Part 15 and amateur operations in this band. This plan balances the differing operational needs of these varied types of uses so that most AVM systems and Part 15 devices will be able to achieve their service objectives without impeding each other's use of the spectrum. We also modify and eliminate outdated regulations that have not kept pace with the technological evolution of AVM and establish a new service, the Location and Monitoring Service (LMS), that both encompasses the old AVM service and future advanced transportation-related services.

2. A key feature of our new spectrum allocation plan is the establishment of separate sub-bands for licensed LMS uses. We have provided three sub-bands for exclusive licensing of wideband "multilateration" LMS systems in addition to two sub-bands for the sharing of narrowband "non-multilateration" LMS systems. Subject to grandfathering certain existing AVM licensees, mutually exclusive applications for multilateration LMS licenses in the three sub-bands will be resolved through competitive bidding. We also clarify the status of licensed systems in the 902-928 MHz band in relation to other uses of the band, with distinctions made for amateur radio and unlicensed Part 15 users operating under certain, specified parameters. The new band plan, combined with the provisions for continued amateur and unlicensed Part 15 operation, will allow efficient and competitive use of the spectrum. Our decisions herein also provide certainty for all users of the band so they can invest in the equipment and facilities necessary to bring quality, low cost services to consumers.

## II. BACKGROUND AND EXECUTIVE SUMMARY

3. The Commission initiated the AVM service in 1974, when it adopted its Report and Order in Docket No. 18302.<sup>1</sup> In the 1974 Order, we found that AVM had the potential to accommodate a number of important functions, such as tracking and monitoring large fleets of vehicles and providing information to allow more efficient use of vehicles through better dispatch and routing information.<sup>2</sup> We also noted that AVM systems had already been

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<sup>1</sup> Report and Order, Docket No. 18302, 30 RR 2d 1665 (1974) (1974 Order).

<sup>2</sup> Id.

operating for several years on an experimental and developmental basis, allowing us to gain valuable information regarding advances in AVM technology.<sup>3</sup> While recognizing the technological progress made by AVM, we concluded that development of new vehicle monitoring technologies was also likely in the future, making it inadvisable to adopt permanent rules until more information was available regarding the viability of such new technologies. Accordingly, we decided to provide for the licensing of AVM systems on both a permanent and a developmental basis under "interim" rules.<sup>4</sup> These rules have remained in effect until now.

4. Our 1974 AVM rules provide for licensing of AVM systems in the 903-912 and 918-927 MHz bands, as well as in several bands below 512 MHz. While little licensing of AVM has occurred below 512 MHz, there has been significant AVM use of the 900 MHz bands in recent years. Existing AVM systems in these bands generally fall into one of two broad technological categories: multilateration systems and non-multilateration systems. Multilateration systems use spread-spectrum technology to locate vehicles (and other moving objects) with great accuracy throughout a wide geographic area. This technology is used, for example, by trucking companies to locate and track their vehicle fleets, by municipal governments to pinpoint the location of their buses,<sup>5</sup> and by entrepreneurs who are developing subscriber-based, stolen vehicle recovery systems.<sup>6</sup> Non-multilateration systems use narrowband technology to transmit data to and from vehicles passing through a particular location. This technology is now providing valuable services to state and local governments operating various types of automated toll collection systems -- with an estimated 500,000 cars currently served by such systems<sup>7</sup> -- and by the railroad industry in the monitoring of their

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<sup>3</sup> The Commission first licensed AVM on a developmental basis in 1968. In 1972, the Commission sought additional information on the development of AVM since its original inquiry and proposed to adopt rules for permanent licensing. See Further Notice of Inquiry and Notice of Proposed Rule Making, Docket No. 18302, 35 FCC 2d 692 (1972).

<sup>4</sup> 1974 Report and Order at para. 5.

<sup>5</sup> See Joe Dysart, *Bus 54, Where are You? Automatic Vehicle Locator System Used by Baltimore Mass Transit Administration*, Mass Transit (July 1991).

<sup>6</sup> See Teletrac petition at 6-14.

<sup>7</sup> Moshe Ben-Akiva et al, *The Case for Smart Highways; Intelligent Vehicle-Highway Systems*, Technology Review (July 1992) (noting that electronic toll collection devices have already been implemented in Dallas, Oklahoma and Louisiana); Terry Sweeney, *Wireless Net to Keep Traffic, Tolls Flowing*, Communications Week (Feb. 8, 1993) (describing plans for a California toll collection system, which is expected to reduce traffic, fuel costs and air pollution). Drivers simply purchase an electronically encoded tag that allows them to drive at a normal speed through the toll station. Electronic readers transmit a radio signal to passing cars, debiting the tag or recording the identification of the tag for monthly billing. Id.; *For Whom the Card Tolls*, Electronics (July 25, 1994) at 9 (noting that 500,000 cars take advantage of automated toll systems).

systems' railway cars.<sup>8</sup>

5. It is expected that in the coming years both types of LMS systems will play an integral role in the development and implementation of the variety of radio advanced transportation-related services, known as "Intelligent Vehicle Highway Systems" (IVHS) or "Intelligent Transportation Systems" (ITS).<sup>9</sup> The ITS is a collection of advanced radio technologies that promise to improve the efficiency and safety of our nation's highways, reduce harmful automobile emissions, promote more efficient energy use, and increase national productivity.<sup>10</sup> For example, it is anticipated that ITS systems will increase traffic mobility and efficiency by notifying motorists of traffic delays and recommending alternate routes, adjusting the settings of traffic signals to prevent anticipated traffic jams, and providing navigational assistance to direct a car to its destination according to the most efficient route. ITS warning systems can also be used to notify drivers of impending collisions (or even take control of the vehicle to avoid a collision), and display electronic traffic and safety signals on a car's windshield when poor weather conditions impair drivers' vision of road-side signs. It is estimated that ITS will help reduce air pollution caused by automobiles and will cut wasteful fuel consumption. Traffic congestion, which costs the United States \$100 billion annually in lost productivity, will also be minimized by innovative ITS traffic management technologies. Finally, ITS is expected to create new economic and employment opportunities. Not all of these services, however, require or rely on the use of the 902-928 MHz band.

6. To recognize the expected growth of ITS, this Report and Order creates a new subpart in Part 90 for Transportation Infrastructure Radio Services (TIRS). The Location and Monitoring Service (LMS), which uses the 902-928 MHz band, constitutes the first service contained within the TIRS category. As we allocate additional spectrum or create new services intended to further the efficiency of the nation's transportation infrastructure,

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<sup>8</sup> See also, comments of Amtech Corporation (Amtech) at 3-5; Mark IV IVHS Division (Mark IV) at 1; and Hughes Aircraft Company (Hughes) at 4.

<sup>9</sup> The term "Intelligent Vehicle Highway System (IVHS)" refers to the collection of advanced radio technologies that, among other things, is intended to improve the efficiency and safety of our nation's highways. Recently, both government and industry entities have begun referring to these technologies by the term "Intelligent Transportation System (ITS)."

<sup>10</sup> See Intermodal Surface Transportation Efficiency Act of 1991, Pub. L. No. 102-240, § 6052(b), 105 Stat. 1914, 2189 (1991) (ISTEA); H.R. Rep. No. 171(I), 102d Cong., 1st Sess. 11 (1991), *reprinted in* 1991 U.S. Code Cong. & Admin. News 1537; IVHS America, Strategic Plan for Intelligent Vehicle-Highway Systems III-31-III-35 (May 1992) (IVHS Strategic Plan). ISTEA calls for the development of a national IVHS program employing advanced traffic management systems, advanced traveler information systems, advanced vehicle control systems, commercial vehicle operations and advanced public transportation systems. ISTEA at §§ 6053-58. Congress also imposed reporting requirements to monitor the progress made in developing and implementing the IVHS program. Id.

these new services will likely be regulated under the TIRS.<sup>11</sup> The TIRS will thus further Congress's goal of encouraging ITS by providing an organized and unified approach towards regulating spectrum for ITS-related services. Today's creation of the TIRS clearly demonstrates this agency's commitment to the continued integration of radio-based technologies into the nation's transportation infrastructure and our commitment to the development and implementation of the nation's intelligent transportation systems of the future.

7. AVM systems share their portion of the 902-928 MHz band with other users.<sup>12</sup> The band is allocated on a primary basis for use by Government radiolocation systems and Industrial, Scientific, and Medical (ISM) equipment, with Government fixed and mobile operations secondary to these users.<sup>13</sup> Amateur Radio Service licensees operate in the entire band, but on a secondary basis to the ISM, Government and AVM users. Part 15 uses are permitted in this band, but are secondary to all other uses, including AVM and amateur operations.

8. In 1989 and 1990, we also modified our rules to permit enhanced operation of spread spectrum-based radio devices throughout the 902-928 MHz band on an unlicensed basis, pursuant to Part 15 of our Rules.<sup>14</sup> Since modifying our rules to provide for enhanced Part 15 operations, a large number of equipment manufacturers and entrepreneurial companies have developed radio devices and implemented radio systems employing spread-spectrum technology in the 902-928 MHz band. It is estimated that several million Part 15 devices have been sold and are being used every day to provide a wide variety of valuable services to the American public. For example, consumers are now able to purchase cordless telephones operating in the band offering high quality voice operations,<sup>15</sup> wireless local area networks are being implemented in offices and buildings to enable tetherless voice and data

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<sup>11</sup> We recently adopted two proceedings that suggest potential spectrum allocations for ITS-type operations. In the Notice of Proposed Rule Making in ET Docket No. 94-32, we suggest the possible allocation of the 2390-2400 MHz or the 2300-2310 MHz bands for short range ITS services and in ET Docket No. 94-124, we suggest providing 3.2 GHz of spectrum (47.2 - 47.4 GHz, 76-77 GHz, 94.7-95.7 GHz, and 139 -140 GHz) for ITS-related automobile radar technologies.

<sup>12</sup> AVM services are allocated the 903-912 and 918-927 MHz portions of the 902-928 MHz band and are licensed on a shared basis.

<sup>13</sup> For additional information on Federal Government use in this band see Federal Government Spectrum Usage in the 902-928, 2400-2500, and 5725-5875 MHz Bands. This document is available from the National Technical Information Service, Springfield, VA, 22161, NTIS No. PB 93176739.

<sup>14</sup> See *Report and Order*, Gen. Docket No. 87-389, 4 FCC Rcd 3493 (1989) and *Report and Order*, Gen. Docket No. 89-354, 5 FCC Rcd 4125 (1990).

<sup>15</sup> See Comments of the Consumer Electronics Group at 4.

transmission,<sup>16</sup> and utility companies are now able to read residential utility meters from the street or remote locations using Part 15 radio devices.<sup>17</sup> In addition to the enormous benefits to both businesses and consumers that will result from the continued growth in the use of the Part 15 industry, our nation's economy also benefits due to the continued development of these new, advanced radio technologies by American companies.<sup>18</sup>

9. On May 28, 1992, North American Teletrac and Location Technologies (Teletrac) filed a Petition for Rule Making requesting that we adopt permanent rules for licensing AVM systems.<sup>19</sup> On March 11, 1993, in response to Teletrac's petition, we adopted the Notice of Proposed Rule Making (Notice) in this proceeding to examine the future licensing and continued development of AVM systems.<sup>20</sup> In the Notice, we proposed to replace the existing interim rules for AVM with permanent rules. We also proposed to expand the technical parameters of the service to permit locating and monitoring of people and objects, as well as vehicles, and therefore proposed to rename the service as the Location and Monitoring Service (LMS). Additionally, we proposed to allocate the entire 902-928 MHz band for LMS, with separate allocations for multilateration LMS systems and non-multilateration LMS systems. We proposed that all LMS systems operate on a shared basis.

10. In response to our Notice, we received numerous comments and reply comments from LMS service providers, LMS licensees that use LMS systems to meet their own internal needs (such as railroad companies and local government entities), LMS users, manufacturers and users of Part 15 equipment, and Amateur operators. We solicited further comments and reply comments in response to ex parte communications we received.<sup>21</sup> Commenters offered a wide array of suggestions on the many complex issues raised in the Notice. Although we are adopting many of the proposals set forth in our Notice, the comprehensive record developed in this proceeding has led us to modify some of our proposals, especially as they concern the spectrum available for the different types of LMS systems, the licensing procedures for the band, and the general obligations of various users of the band.

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<sup>16</sup> See e.g., Comments of Cylink.

<sup>17</sup> See Ex Parte Comments of Cellnet dated March 15, 1994, at 2.

<sup>18</sup> See Comments of Symbol Technologies at 3-4.

<sup>19</sup> RM-8013, filed May 28, 1992, and placed on Public Notice June 23, 1992, Report No. 1897. Teletrac's request was primarily directed at the tentative nature of "interim" rules as well as the exclusivity of AVM licenses.

<sup>20</sup> Notice of Proposed Rule Making, PR Docket No. 93-61, 8 FCC Rcd. 2502 (1993).

<sup>21</sup> See Public Notice, DA 94-129, PR Docket No. 93-61, 59 Fed.Reg. 7239 (February 15, 1994).

11. Multilateration and non-multilateration LMS systems, amateur operations, and Part 15 devices will all play an important role in providing valuable services to the American public in the coming years. We believe that our decisions in this proceeding recognize this importance and will enable all of these services to make continued use of this spectrum. As detailed in our later discussion, commenters representing each of these services indicate the need for varying amounts of spectrum and varying degrees of interference protection from each other's operations in the band. We have therefore developed a spectrum plan that attempts to accommodate all of these users' requirements. The plan: 1) continues to permit secondary operations by unlicensed Part 15 and amateurs across the entire band, but affords users in these services a greater degree of protection to their operations; 2) enables non-multilateration LMS systems to operate on spectrum separate from multilateration systems; and 3) allocates spectrum on an exclusive basis for multilateration LMS licensees.

12. In this Report and Order we have therefore made the following decisions:

- Change the name of this service from the Automatic Vehicle Monitoring (AVM) to the Location and Monitoring Service (LMS) (see paragraph 1).

- Change the terminology used to refer to the two general categories of LMS technologies from "wideband" and "narrowband" to "multilateration" and "non-multilateration," respectively, (see paragraph 14).

- Permit multilateration LMS systems to locate any object -- animate or inanimate -- ancillary to their primary vehicular location and monitoring services (see paragraph 24).

- Permit LMS systems to transmit and receive status and instructional information, both non-voice and voice, related to the location and monitoring of a mobile unit and permit LMS systems to interconnect with the Public Switched Network (PSN) on a restricted basis (see paragraphs 26-27).

- Expand LMS license eligibility to all entities eligible to be licensed under Part 90 of our Rules and allow service in the 902-928 MHz band to be provided by LMS licensees to both individuals and the Federal Government on a commercial basis to paying subscribers. (see paragraph 28).

- Clarify what constitutes harmful interference to multilateration licensees by unlicensed Part 15 devices and amateur operations (see paragraphs 35-36).

- Allocate an additional 8 MHz of spectrum in the 902-928 MHz band for LMS use, permitting the entire band to be used for this purpose. Adopt a spectrum allocation scheme for the 902-928 MHz band that assigns separate sub-bands for multilateration and non-multilateration operations as follows (see paragraphs 46-49):

<u>Band (MHz)</u>	<u>System License</u>
902.000 - 904.000	Non-multilateration
904.000 - 909.750	Multilateration
909.750 - 919.750	Non-multilateration
919.750 - 921.750	Multilateration and Non-Multilateration
921.750 - 927.250	Multilateration
927.250 - 928.000	Multilateration <sup>22</sup>

■ License exclusive multilateration LMS systems within each Major Trading Area (MTA)<sup>23</sup> and four additional MTA-like service areas<sup>24</sup> in the three sub-bands designated above, and resolve mutually exclusive applications through competitive bidding (see paragraphs 50-57).

■ Grandfather base stations of multilateration system licensees authorized as of February 3, 1995 and constructed and in operation by April 1, 1996 (see paragraphs 61-64).

■ License non-multilateration systems on a shared basis in the three sub-bands designated above (see paragraphs 69-70).

■ Allow multilateration licensees to commence operations only after demonstrating interference with Part 15 operations is minimized (see paragraphs 81-82).

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<sup>22</sup> This is not considered a separate sub-band. Each licensee in the 904.000-909.75 MHz, 919.750-921.750 MHz and 921.750-927.250 MHz sub-bands will obtain a narrowband assignment at the top of the 902-928 MHz band for forward link operations, as follows: 927.250-927.500 MHz for the 921.750-927.250 MHz band; 927.500-927.750 MHz for the 919.750-921.750 band; and 927.750-928.000 MHz for the 904-909.750 band.

<sup>23</sup> Rand McNally organizes the 50 states and the District of Columbia into 47 MTAs. See Rand-McNally Commercial Atlas and Marketing Guide, 36-39, (123d ed. 1992). PCIA and Rand McNally have recently entered into an agreement regarding the use of Rand McNally's market area designations (i.e., Basic Trading Areas (BTAs) and Major Trading Areas (MTAs) for the licensing of various mobile radio services. The listings of the Major Trading Areas, including the counties, parishes and census divisions that comprise each MTA, available for public inspection in the Office of Engineering and Technology's Technical Information Center, 2nd Floor, 2000 M Street, N.W., Washington, D.C.

<sup>24</sup> The four additional regions are: (1) Guam and the Northern Mariana Islands; (2) the Commonwealth of Puerto Rico and the U.S. Virgin Islands; (3) American Samoa; and (4) Alaska will be treated as a single area separate from the Seattle MTA. This is consistent with our MTA-based service area definitions for broadband PCS (see 47 C.F.R. § 24.102) and for the Commercial Mobile Radio Services.



### III. DISCUSSION

#### A. Definitions

13. In the Notice, we characterized LMS systems as "wideband" and "narrowband." A number of commenters, including Mark IV, Hughes, Amtech, and Pinpoint, suggest that LMS systems should be categorized as either "wide-area" or "local-area" rather than as "wideband" or "narrowband."<sup>25</sup> These commenters state that because some "narrowband" systems require a bandwidth in excess of 2 MHz it would be inappropriate to categorize these systems as narrowband. Teletrac opposes such a change in terminology, claiming that it would be difficult to distinguish wide-area/local-area systems without reference to a specific coverage standard.<sup>26</sup>

14. While we agree that the wideband/narrowband terminology used in the Notice is imprecise and could be misleading, we believe that characterizing systems as "wide-area" or "local-area" could also lead to confusion because not all LMS systems have predetermined service contours. Therefore, to address commenters' concerns, we shall refer to "wideband" pulse ranging systems as "multilateration" systems, and we shall refer to "narrowband" systems as "non-multilateration" systems. We define multilateration systems as systems that are designed to locate vehicles or other objects by measuring the difference of time of arrival, or difference in phase, of signals transmitted from a unit to a number of fixed points or from a number of fixed points to the unit to be located. We define non-multilateration systems as systems that employ any technology other than multilateration technology to transmit information to and from vehicles. Unlike a multilateration AVM system, which determines the location of a vehicle or object somewhere over a wide area, a typical non-multilateration AVM system uses an electronic device placed in a vehicle to transfer information to and/or from that vehicle. When the vehicle passes near one of the system's stations, the station transmits an interrogating signal. The interrogating signal is then either modulated with unit-specific information and reflected back to the station's receiver or the tag transmits its own signal in response to the interrogation. By dividing LMS into the broad multilateration and non-multilateration categories, we adopt a definitional framework that is flexible enough to accommodate all operational modes LMS is anticipated to evolve towards.

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<sup>25</sup> See Mark IV comments at n.2; Hughes comments at 6-7; Amtech comments at n.3; Pinpoint comments at n. 3.

<sup>26</sup> Teletrac reply comments at 31-33.

## **B. Permanent LMS Operation in the 902-928 MHz Band**

15. In addition to the current allocation within the 902-928 MHz band for AVM, this band is currently allocated for Industrial, Scientific, and Medical (ISM) equipment,<sup>27</sup> radiolocation, fixed and mobile by the Federal Government,<sup>28</sup> amateur operations,<sup>29</sup> and unlicensed operation of devices under Part 15 of the Rules.<sup>30</sup> In addition, we have initiated a proceeding exploring the possibility of making the middle portion of the 902-928 MHz band available for non-government wind profiler radar systems.<sup>31</sup> Because of the diversity of services that share this band, many commenters observe that changes in the rules that relate to one group of users could affect the other users of the band. A number of commenters further argue that it is premature to adopt permanent rules for LMS systems because many LMS system operators, Part 15 users, and amateur operators are implementing new technologies.<sup>32</sup> Other commenters urge us to take additional time to study the relative merits of the various services, devices, and technologies; still others argue that changes in the rules should be delayed to permit creation of a technical committee to study the sharing of the band among its various users.<sup>33</sup> Relatedly, the American Radio Relay League (ARRL) filed a petition for rule making, dated January 13, 1994, requesting a primary allocation of 902-904 and 912-918 MHz for the Amateur Radio Service.<sup>34</sup>

16. Notwithstanding these concerns, we believe that delaying implementation of permanent rules for LMS systems could jeopardize the continued development of this service. Although a number of companies have already developed LMS systems and are on the verge

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<sup>27</sup> See 47 C.F.R. § 18.305.

<sup>28</sup> See 47 C.F.R. § 2.106.

<sup>29</sup> See 47 C.F.R. § 97.301.

<sup>30</sup> See 47 C.F.R. §§ 15.243, 15.245, 15.247 and 15.249.

<sup>31</sup> See Notice of Proposed Rule Making and Notice of Inquiry, Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum for Wind Profiler Radar Systems, (NPRM/NOI), ET Docket 93-59, 8 FCC Rcd 2546 (1993).

<sup>32</sup> See generally comments of the Telecommunications Industry Association (TIA); the Part 15 Coalition (Coalition); Spectralink, the North American Telecommunications Association (NATA); the Domestic Automation Company (DAC); Itron, Inc. (Itron); Symbol Technologies, Inc. (Symbol); Telxon Corporation (Telxon); Thomson Consumer Electronics (Thomson); Norand Corporation (Norand); and American Radio Relay League, Inc. (ARRL).

<sup>33</sup> Coalition comments at 12; Interdigital comments at 6-7; Spectralink comments at 5; Uniplex comments at 2; and TIA comments at 5.

<sup>34</sup> The Petition for Rule Making filed by the American Radio Relay League, because it involves matters that are under consideration in this docket, was accepted as Comments in this proceeding.

of making services widely available, they argue that uncertainty about possible changes in our rules has deterred or prevented them from committing greater capital or obtaining financing.<sup>35</sup> In addition, LMS equipment manufacturers, state and local government entities, toll road operators, and Part 15 manufacturers and users require regulatory certainty. Further postponement of final decisions regarding our LMS rules would make it difficult for users of the band to plan the long-term development of their products or services.<sup>36</sup> Establishing permanent rules for LMS will also provide opportunities for new entrants into location and monitoring businesses. Accordingly, we find that it is in the public interest and consistent with Commission precedent to adopt permanent rules for location and monitoring services.

17. A number of other commenters argue that even if permanent rules are adopted, the Commission should find a permanent home for some or all LMS systems in another frequency band. For example, Lockheed, a manufacturer of narrowband LMS equipment, argues that the 902-928 MHz band is an inappropriate place for LMS systems and proposes use of the 5.8 GHz band. Saab requests an exclusive allocation in the 2450-2470 MHz band for an Electronic Toll and Traffic Management (ETTM) Service claiming that this is neither a narrow-band nor a wide-band LMS service.<sup>37</sup> The Part 15 Coalition also suggests that LMS services be moved to the 2390-2400 MHz band that is part of the 50 MHz transferred to the FCC by NTIA.<sup>38</sup> Other commenters suggest that we should restrict or eliminate multilateration LMS systems in the 902-928 MHz band and instead promote alternative location technologies such as Global Positioning Satellite (GPS), LORAN, dead reckoning, or cellular systems.<sup>39</sup>

18. We conclude not only that the 902-928 MHz band should continue to be made available for LMS services, but that the 8 MHz within the band not previously allocated to AVM should also now be available for LMS. Although prior AVM operation in the band has occurred under interim rules, we have always regarded the band as a permanent home for

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<sup>35</sup> See, for example, Ex Parte Comments of MobileVision dated August 12, 1994 at 2.

<sup>36</sup> Teletrac comments at 4; MobileVision reply comments at 3.

<sup>37</sup> SCG comments at 3-5; Sensormatic comments at 17-20; Part 15 Coalition comments at 13-15; Saab-Scania Combitech (Saab) comments at 11; and Lockheed comments at 4. ETTM systems do fall into the "non-multilateration" LMS category (see para. 14 supra.) and as such are adequately accommodated in our licensing plan.

<sup>38</sup> Comments of the Part 15 Coalition at 8-9; Further Comments of the Part 15 Coalition.

<sup>39</sup> AT&T comments; TIA comments at 2-4; and NATA comments at 11-13.

AVM.<sup>40</sup> The 903-912 and 918-927 MHz segments of this band are currently the only spectrum specifically allocated for AVM use and there exists no other low-cost, consumer-oriented spectrum where AVM service providers operate their systems without facing concerns similar to those present in this band. The 902-928 MHz band is ideally suited for location services due to the propagation characteristics of the band that permit widespread coverage of a market area without the use of an inordinate number of base stations. In addition, while some commenters argue that GPS or terrestrial-based communications systems with location capabilities are more spectrally efficient,<sup>41</sup> we are not persuaded that LMS should be eliminated from the 902-928 MHz band on this basis. The alternative technologies put forward by commenters have disadvantages as well as advantages in comparison to LMS. For example, GPS and LORAN-based systems used in fleet tracking permit a vehicle to determine its location, but a separate communications link is required to transmit this information back to a dispatch location. Similarly, Lojack, Inc. (Lojack) manufactures a vehicle location system that operates on a single channel in the 170 MHz band, but this system requires use of direction-finding antennas to locate the vehicle. By contrast, multilateration LMS systems use larger amounts of spectrum, but can both receive "fixes" on large numbers of vehicles and transmit messages back to such vehicles from a central source -- all within one integrated system.

19. We further conclude that the public will be best served by expanding the current AVM allocation of 18 MHz to include an additional 8 MHz so that LMS will be permitted to use the entire 902-928 MHz band. This will allow development of diverse LMS services and technologies. LMS providers are already developing systems with differing capacities, and future designs may surpass the capacity of systems available today. In addition, we believe that developing a diversity of LMS services is important to promote competition and continued technological advances. Promoting alternative technologies will provide consumers choices of a variety of locating services, enabling them to address their individual communications needs. The demand and need for greater capacity, capability and alternatives will grow. Thus, providing additional spectrum for LMS systems within the 902-928 MHz band allows for development of the full scope of location and monitoring techniques.<sup>42</sup>

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<sup>40</sup> In the Report and Order in Docket 18302, we stated that the interim nature of the rules was to allow continued development of AVM systems under a flexible licensing arrangement and to allow the rules to be fine tuned as additional information is gained regarding the operation of various types of AVM systems. Report and Order, Docket No. 18302, at paras. 5 and 10, 30 RR 2d 1665 (1974).

<sup>41</sup> See Comments of the Portland Amateur Radio Club (PARC), Technology Radio Amateur Club (TRAC), the Part 15 Coalition, Spectralink Corporation (Spectralink), American Telephone and Telegraph Company (AT&T), and NATA.

<sup>42</sup> See Report and Order, Docket No. 18302 at para. 10, 30 RR 2d 1665 (1974).

### C. Eligibility and Permissible Uses

20. As discussed in the Notice, LMS systems have the potential to offer a wide array of services that go beyond the mere tracking of vehicles.<sup>43</sup> We therefore proposed to expand the permissible uses of LMS to include the location of all animate and inanimate objects.<sup>44</sup> In addition, we proposed expanding the types of entities eligible to acquire LMS service to include individuals and the Federal Government,<sup>45</sup> and we proposed to allow LMS service to be rendered on a for-profit basis.<sup>46</sup> We requested comment on whether these proposals to expand eligibility and permissible uses would create unacceptable congestion of the 902-928 MHz band.<sup>47</sup>

21. In response to the Notice, providers of multilateration LMS services contend that there are significant potential public benefits to expanding LMS beyond vehicle location alone.<sup>48</sup> Southwestern Bell Mobile Systems (SBMS) urges that the definition of LMS be further expanded to permit messaging and data transmissions to fixed units and units for which location and monitoring is not being provided.<sup>49</sup> Additionally, certain multilateration providers have requested that it be made clear that LMS will be permitted to provide interconnected service to the public switched network (PSN).<sup>50</sup> Other commenters, however, such as IVHS America and the United States Department of Transportation (DOT), argue that LMS should remain primarily a vehicle-oriented service, with an emphasis on ITS-related communications.<sup>51</sup> Part 15 manufacturers and users and amateur operators also contend that expansion of the possible uses of LMS will result in more intensive use of the band, thus leading to severe spectrum congestion.<sup>52</sup>

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<sup>43</sup> Notice 8 FCC Rcd 2502, 2503 (1993).

<sup>44</sup> Id. at para 9.

<sup>45</sup> Id. at para. 7.

<sup>46</sup> Id. at para. 8.

<sup>47</sup> Id.

<sup>48</sup> Teletrac comments at 9-10; MobileVision comments at 41-43; SBMS comments at 3-7; and Location Services comments at 6.

<sup>49</sup> SBMS comments at 3-7.

<sup>50</sup> Ex Parte Comments of MobileVision, Teletrac and Uniplex dated December 12, 1994, at 2.

<sup>51</sup> IVHS America comments at 16; DOT reply comments at 15.

<sup>52</sup> See comments of Sensormatic Electronics (Sensormatic); TIA; the Part 15 Coalition; Interdigital Communications (Interdigital); Spectralink; NATA; DAC; Itron; Symbol; Telxon; Thomson; Norand; the Alarm Industry Communications Committee (Alarm Industry); ARRL; PARC;

22. Commenters also express diverse views on whether LMS licensees should be allowed to provide for-profit service. SBMS and Southern California Gas Company (SCG) support offering multilateration LMS as a subscriber-based private radio service.<sup>53</sup> MobileVision also supports permitting LMS licensees to provide services to paying subscribers, stating that such licensing "recognizes the massive capital cost incumbent in deploying the type of extensive infrastructure required for an LMS system of appropriate scope and scale to effectively serve a market."<sup>54</sup> On the other hand, the American Radio Relay League (ARRL) and the Part 15 Coalition oppose allowing multilateration LMS licensees to provide subscriber-based service.<sup>55</sup>

23. We recognize the concerns of the Part 15 and amateur communities that the expansion of permissible uses of the LMS service will result in more intensive use of the 902 - 928 MHz band. Unfettered interconnection and messaging in the LMS could not only increase the potential for harmful interference to other users of the band, but detract from the intended purpose of the LMS allocation. Based on these concerns, we conclude that while a limited expansion of potential applications of LMS is warranted, operational restrictions should be imposed to maintain the coexistence of the many varied users of the band. We find therefore that it is appropriate to impose: 1) limitations on the provision of non-vehicular location services; 2) restrictions on messaging services and interconnection and; 3) a prohibition against message and data transmissions to fixed units and units for which location and monitoring is not being provided. We believe that these restrictions strike an equitable balance between the needs of LMS service providers and those of the Part 15 users and manufacturers and amateur operators, and additionally ensure that LMS systems are utilized primarily for location service and not as a general messaging or interconnected voice or data service. To ensure compliance with these restrictions, we may request, and licensees shall supply, whatever records or information necessary to demonstrate that these provisions are being followed.

24. Accordingly, we will allow non-vehicular location services to be rendered only by multilateration LMS systems whose primary operations involve the provision of vehicle location services. This limited expansion of permissible LMS uses recognizes the general capability of multilateration systems to cover a wide area and perform location determinations for any type of object within that area. We believe that non-multilateration systems, however, should continue to be used for vehicle monitoring only because the

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and TRAC.

<sup>53</sup> See Comments of SBMS dated June 29, 1993, at 4; and Comments of SGC dated June 29, 1993, at 2-3 ("private carrier" support, but outside of 902-928 MHz).

<sup>54</sup> MobileVision Comments dated June 29, 1993, at 40-41.

<sup>55</sup> See Comments of ARRL dated June 29, 1993, at 11-12; and Comments of the Part 15 Coalition at 16.

spectrum they occupy has a heavier concentration of amateur radio operators, Part 15 devices and Federal Government radiolocation operations than other portions of the band. We are concerned that permitting non-multilateration systems to provide this additional service will cause more intensive use of the sub-band, to the detriment of these other users.

25. While we expand the potential applications of LMS as described above, we decline to allow LMS to be used for the type of messaging proposed by Southwestern Bell. We agree with numerous commenters who argue that creating such a broad messaging and data service would be an inappropriate use of this spectrum.<sup>56</sup> The LMS service is a mobile location and monitoring service. We do not intend to expand use of this band so that it becomes primarily a fixed, point-to-multipoint or point-to-point messaging service. Our rules make adequate provision elsewhere for this type of communications.<sup>57</sup> The 902-928 MHz band, however, is the only allocation for location services that provides sufficient spectrum to accommodate the types of advanced location and monitoring systems currently being implemented. Although there are other methods and spectrum available to determine the location of a unit, these other methods do not offer the same capabilities or potential as systems developed in the 902-928 MHz band.<sup>58</sup>

26. We do not intend for this service to be used for general messaging purposes. Accordingly, we will require that all messaging be associated with the location or monitoring of the vehicle or unit. We will permit communications necessary to provide accurate, timely and complete status and instructional information relating to the vehicle being located or the occupant(s) of the vehicle, including voice communications. Thus, LMS systems will be permitted to transmit status and instructional messages, either voice or non-voice, so long as they are related to the location or monitoring functions of the system. We find that such use of LMS will be invaluable to the implementation of ITS of the future.<sup>59</sup>

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<sup>56</sup> TIA comments at 6; Interdigital comments at 3; Alarm Industry comments at 7; Ademco comments at 4; Consumer Electronics Group of the Electronic Industry Association (EIA/CEG) comments at 5; and Proxim, Inc. (Proxim) comments at 3. Uniplex notes that the NPRM requires that messages be related to the unit being located but urges that tighter restrictions be placed on messages, Uniplex comments at 3.

<sup>57</sup> See generally, Parts 21 and 94 of our Rules, 47 C.F.R. Part 21 and 94.

<sup>58</sup> See para. 18, supra.

<sup>59</sup> Both IVHS America and DOT emphasized the need for sufficient communications capacity to implement ITS services, including Advanced Traffic Management Systems, Advanced Traveler Information Systems, Advanced Vehicle Control Systems, Commercial Vehicle Operations, and Advanced Public Transportation Systems. See comments of IVHS America and DOT. See also Strategic Plan for Intelligent Vehicle Highway Systems in the United States, prepared by IVHS America. Implementation of such an array of ITS services will require substantial communications capacity and a combination of various technologies to provide sufficient location and traffic management information in many different circumstances.

27. In addition, we will permit limited LMS interconnection.<sup>60</sup> We will permit "store and forward" interconnection, where either (1) transmissions from a vehicle or object being monitored are stored by the LMS provider for later transmission over the PSN, or (2) transmissions received by the LMS provider from the PSN are stored for later transmission to the vehicle or object being monitored. We will not permit real-time interconnection between vehicles or objects being monitored and the PSN, except for emergency communications related to a vehicle or a passenger in a vehicle.<sup>61</sup> Additionally, the vehicle or object being monitored may only send or receive real-time interconnected communications to or from entities eligible in the Public Safety or Special Emergency Radio Services<sup>62</sup> or a system dispatch point. Finally, the requirement discussed above that all messages be associated with the location or monitoring of the vehicle continues to apply. We believe these limitations on interconnection will serve to impede the proliferation of interconnected voice and data communications by LMS systems while also providing them the flexibility to better serve the subscribers to the service.<sup>63</sup>

28. Finally, we find it in the public interest to allow LMS licensees to make service available to individuals and the Federal Government in addition to Part 90 eligibles. This step will effectively enable LMS operators to serve all members of the public, thus increasing the potential for the public to benefit from the expansion of ITS services. In addition, because many LMS systems will entail construction of extensive infrastructure over wide geographic areas, we also find it in the public interest to permit LMS to be offered to paying subscribers. By permitting LMS offerings to be structured as commercial subscriber-based service, we afford licensees a realistic means of underwriting system development.

#### **D. Accommodation of Secondary Users in the 902-928 MHz Band**

29. As noted above, there are currently five separate user groups sharing the 902-928 MHz band. In addition, the relative hierarchy among these users is well established. The 902-928 MHz band is allocated for primary use by the Federal Government for Radiolocation, Fixed and Mobile services and by users of Industrial, Scientific, and Medical (ISM) devices. Use of the spectrum by government fixed and mobile and AVM systems is secondary to both of these uses. The remaining users of the 902-928 MHz band, licensed amateur radio operators and users of Part 15 equipment, operate on a secondary basis to all

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<sup>60</sup> We note that Part 15 devices performing functions similar or identical to those of licensed LMS operations are not restricted from interconnecting with the PSN.

<sup>61</sup> Emergency communications may include information about a medical condition that requires immediate attention or the mechanical breakdown or failure of an automobile.

<sup>62</sup> See 47 C.F.R. Part 90, Subparts B and C. This would also permit "911" interconnection where this service is available.

<sup>63</sup> See Ex Parte Comments of MobileVision dated December 14, 1994, at 5-6.



other uses, including AVM. In the Notice, we requested comment on whether LMS systems would be able to share the band with these other classes of users. The Notice also sought comment on whether a warning label should be required on LMS instruction manuals, operator manuals, and brochures to warn potential LMS users that LMS systems are secondary to Federal Government users and to ISM equipment.<sup>64</sup> The Notice also requested comment on potential alternatives to LMS sharing with other user categories, "short of removing Part 15 users and amateur operations from the band, restricting where such users could operate in the band, or placing stricter limitations on the operation of such users in this band."<sup>65</sup>

30. The Federal Government and ISM users did not comment on sharing of the band, and LMS manufacturers and users generally did not express concern about continued sharing of the spectrum with either the Federal Government or ISM equipment. The American Radio Relay League (ARRL), however, requests that we provide a primary allocation in a portion of the 902-928 MHz band for amateur operations.<sup>66</sup> The Interagency Group requests that LMS systems providing electronic toll and traffic management (ETTM) services be given co-primary status with Federal Government and ISM users, claiming that this is required to "instill confidence" in ETTM users that their long-term use of this band is assured.<sup>67</sup> We do not believe that these considerations warrant disturbing the primary status of Federal Government and ISM operations in relation to other uses of the band. Therefore, under the rules adopted today, LMS licensees will continue to operate on a secondary basis to Federal Government users and ISM equipment. Further, we conclude that no primary allocation for amateur operations in the requested sub-bands is warranted. Although the ARRL states that there has been "rapid increases in amateur use",<sup>68</sup> that "the Amateur Radio Service is increasingly looking to the 902-928 MHz band,"<sup>69</sup> and that "amateur use of the band has been growing",<sup>70</sup> the only quantitative support that it provides is that there are 16 known manufacturers of amateur equipment for this band and that there are 20 amateur stations in

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<sup>64</sup> Notice at para. 24, 8 FCC Rcd. 2502, 2506 (1993).

<sup>65</sup> 8 FCC Rcd 2502, 2506-2507 (1993), as revised by Erratum, 8 FCC Rcd 3233 (1993).

<sup>66</sup> See footnote 34, supra. The ARRL requests a primary allocation in the 902-904 MHz and 912-918 MHz bands. Also, by letter to Chairman, Reed E. Hundt, dated October 4, 1994, ARRL asks that the Commission not extend any substantive accommodation for Part 15 entities that is not extended as well to the Amateur service.

<sup>67</sup> Interagency Group comments at 11-12.

<sup>68</sup> ARRL Petition for Rule Making at 3.

<sup>69</sup> ARRL Petition for Rule Making at 10.

<sup>70</sup> ARRL Petition for Rule Making at 9.

Rochester, New York using the band.<sup>71</sup> There are, on the other hand, a large number of various uses of this band with quantitatively known combined (and competing) requirements. They include the existence of more than 4 million Part 15 devices and 500,000 non-multilateration LMS tag readers. ARRL's petition thus fails to adequately justify a change in the allocation status for the Amateur Radio Service in any portion of this band.

31. In the Notice, we proposed that a warning label be required on all LMS instruction manuals, operator manuals, and brochures to warn potential LMS users that LMS systems are secondary to Government radiolocation and to ISM equipment and that, as a result, such systems may suffer from "undesired operation." Notice at para. 24, 8 FCC Rcd. 2502, 2506 (1993). We have decided not to require such a warning label. Many wireless telecommunications systems operate on spectrum that is also allocated for other uses and are susceptible to varying degrees of interference. We generally do not place warning labels on these systems. To do so in this instance might unfairly label LMS as an inferior service to other similarly-situated services, quite possibly deterring growth of the service and reducing the likelihood of prompt public benefit from its use. Moreover, LMS providers have an inherent incentive to minimize the deleterious effects of interference to provide reliable service and to attract and retain a loyal customer base. We do warn LMS licensees and users, however, that many LMS systems in the 902-928 MHz band will be sharing the band with one another, and operating on a secondary basis to Federal Government users and ISM equipment. Systems operating in such an environment are always subject to the possibility of interference, and must comply with our criteria for co-channel sharing where applicable.

32. The relationship between LMS, especially multilateration systems, and Part 15 uses of the 902-928 MHz band presents more complex issues, as the comments indicate. There are millions of Part 15 devices in operation throughout the United States today and this number is expected to increase in the future. Because Part 15 devices operate at extremely low power and each has a limited area of operation, the record indicates that they can coexist more easily with non-multilateration LMS systems, which also operate with relatively short range.<sup>72</sup> Conversely, Part 15 commenters generally contend that they will not be able to effectively share the spectrum with multilateration LMS systems.<sup>73</sup> These commenters believe that Part 15 devices and multilateration LMS cannot coexist in the same band because the high power multilateration transmissions will overpower and desensitize their low power,

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<sup>71</sup> ARRL Petition for Rule Making at note 18.

<sup>72</sup> Ex Parte Comments of Amtech dated March 29, 1994, at 8-9.

<sup>73</sup> See Ex Parte Comments of Ademco dated March 15, 1994 at 5-11; Ex Parte Comments of Part 15 Coalition dated August 12, 1994 at 3; Ex Parte Comments of the Ad Hoc Gas Distribution Utilities Coalition dated August 12, 1994 at 7; Ex Parte Comments of Itron dated August 12, 1994 at 1.

unlicensed operations.<sup>74</sup> Additionally, Part 15 commenters believe that with unrestricted use of high power services, the noise floor will increase throughout the band. They claim that this increase of noise in the band, without a limitation in the power and location of the multilateration transmissions, would make their sensitive receivers -- which must accurately detect low-power signals -- obsolete and unusable anywhere in the 902-928 MHz band.<sup>75</sup> Multilateration LMS commenters argue that operation of some Part 15 devices is likely to cause harmful interference to LMS systems. Examples of potential interference sources identified by multilateration operators include anti-shoplifting field disturbance sensors that operate under Section 15.245 of the rules and certain video links that operate under Section 15.249 of the rules.<sup>76</sup> Multilateration parties also contend that harmful interference is likely to be caused by Part 15 devices that either transmit continuous signals or transmit from antennas placed at relatively high out-of-doors elevations. On the other hand, multilateration proponents do not believe that interference is likely to be received from any other type of Part 15 operations.<sup>77</sup>

33. Commenters have suggested a number of solutions to mitigate potential harmful interference, including 1) limiting the permissible uses for the LMS service, 2) moving the LMS service to another band, 3) elevating Part 15 devices to co-equal status with LMS systems, 4) retaining existing rules until a joint technical committee can be established to study the feasibility of sharing, and 5) giving amateur operators primary status in a part of the band.<sup>78</sup> In ex parte comments filed in mid-August 1994, some LMS commenters discussed additional alternatives for continuing to allow Part 15 operations in the 902-928 MHz band while seeking to minimize possible interference to LMS operations. These commenters focused on establishing thresholds that would determine whether Part 15 devices were causing harmful interference to LMS systems, based on criteria such as field strength limits, height of outdoor antennas used by Part 15 devices, the directional gain of antennas associated with Part 15 devices, and the existence of field disturbance sensors operating under Section 15.245 of our rules.<sup>79</sup> Part 15 commenters, however, had little, if any,

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<sup>74</sup> See Ex Parte Comments of the Part 15 Coalition dated August 12, 1994, at 4.

<sup>75</sup> See e.g., Ex Parte Comments of Cellnet & KNOGO dated August 19, 1994, at 3.

<sup>76</sup> Letter from AirTouch Teletrac, Pinpoint Communications, Inc., Uniplex and MobileVision, L.P., to Ralph A. Haller, Chief, Private Radio Bureau, dated June 23, 1994.

<sup>77</sup> See ex parte comments of Teletrac, MobileVision, Pinpoint and Uniplex, dated June 23, 1994 at 5.

<sup>78</sup> See Ex Parte Comments of Metricom and Southern California Edison Company dated August 12, 1994 at 4; Ex Parte Comments of Symbol Technologies at 3-4; Ex Parte Comments of Part 15 Coalition dated August 12, 1994 at 6-7; Petition for Rule Making filed by the American Radio Relay League (ARRL) on January 13, 1994 at 1.

<sup>79</sup> See Further Comments of AirTouch Teletrac, MobileVision and SBMS dated August 12, 1994.

support for these types of interference threshold criteria.<sup>80</sup>

34. We recognize the important contribution to the public that both Part 15 technologies and amateur operators provide in the 902-928 MHz frequency band. For example, Part 15 devices currently operating in the 902-928 MHz band provide valuable services such as automated meter reading, inventory control, package tracking and shipping control, alarm services, local area networks, and cordless telephones. These devices allow businesses to operate more effectively and efficiently, without the regulatory complexities of many licensed services. The amateur service is used by technically inclined private citizens world-wide to engage in self-training, information exchange, and radio experimentation. It is at the forefront of communications technology and has been instrumental in the development of land mobile systems, hand held radios, and satellite communications. In times of disaster when normal communications are disrupted, amateur systems often alert the world to the disaster and provide assistance in relief operations. By the actions in this proceeding we seek to maximize the ability of Part 15 and amateur operations to coexist with the operation of LMS systems.

35. We also conclude that effective sharing of this band between amateur and Part 15 users and multilateration LMS systems does not require a change in the relative status between these two allocations and uses, as some parties have suggested. Rather, we have decided to balance the equities and value of each use without undermining the established relationship between unlicensed operations and licensed services. Thus, we affirm that unlicensed Part 15 devices in the 902-928 MHz band, as in any other band, may not cause harmful interference to and must accept interference from all other operations in the band;<sup>81</sup> persons operating unlicensed Part 15 devices have no vested or recognizable right to continued use of any given frequency;<sup>82</sup> and finally, an operator of an unlicensed Part 15 device is required to cease operations upon notification by a Commission representative that the device is causing harmful interference and may not resume operations until the condition causing the harmful interference has been corrected.<sup>83</sup> Furthermore, the amateur radio service will retain its status as a licensed, secondary service.

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<sup>80</sup> See Ex Parte Comments of ADEMCO, Axxon Corp., C&K Systems, Gas Utilities, ITRON, Metricom & Southern Cal Edison, NavGuard/Summit Telecom, Sensormatic, Symbol Technologies, Tatung Telecom, Teatherless Access, TIA, Uniplex Corp., Utilicom, UTC, WINFORUM and WISE Communications, August 1994.

<sup>81</sup> 47 C.F.R. § 15.5(b).

<sup>82</sup> 47 C.F.R. § 15.5(a).

<sup>83</sup> 47 C.F.R. § 15.5(c).

36. Amateur and Part 15 operations will continue to be secondary to services with a higher allocation status. They may continue to operate as their licenses and/or the rules permit. To accommodate their concerns about their secondary status in light of multilateration LMS, however, we are adopting rules that define and clarify what constitutes harmful interference from their secondary operations. Harmful interference is defined as "(a)ny emission, radiation or induction that endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with this chapter."<sup>84</sup> To promote cooperative use of the 902-928 MHz band we are elaborating on this standard to define what is not harmful interference from both amateur operations and unlicensed Part 15 devices to multilateration LMS systems. This "negative definition" will promote effective use of the 902-928 MHz band by the various services by clearly establishing the parameters under which licensed Amateurs and unlicensed users of Part 15 devices may operate without risk of being considered sources of harmful interference to services with a higher allocation status. Part 15 and amateur operators who voluntarily operate within the following parameters will not be subject to harmful interference complaints from multilateration LMS systems at 902-928 MHz. Thus, we are adopting rules that provide that a Part 15 device will not be deemed to be causing interference to a multilateration LMS system if it is otherwise operating in accordance with the provisions of 47 C.F.R. Part 15 and it meets at least one of the following conditions:

- (a) it is a Part 15 field disturbance sensor operating under Section 15.245 of the rules and it is not operating in the 904-909.750 or 919.750-928.000 MHz sub-bands;<sup>85</sup> or
- (b) it does not employ an outdoor antenna; or
- (c) if it does employ an outdoor antenna, then if
  - (1) the directional gain of the antenna does not exceed 6 dBi, or if the directional gain of the antenna exceeds 6 dBi, it reduces its transmitter output power below 1 watt by the proportional amount that the directional gain of the antenna exceeds 6 dBi;<sup>86</sup> and
  - (2) either

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<sup>84</sup> 47 C.F.R. § 15.3(m). See also 47 C.F.R. § 2.1.

<sup>85</sup> SBMS and MobileVision stated they supported this field disturbance sensor limitation as an interference determinant. See Ex Parte Comments of SBMS dated August 12, 1994, and Ex Parte Comments of MobileVision dated August 12, 1994. Multilateration entities concur that the majority of interference complaints from Part 15 devices concern field disturbance sensors and long range video links. See the LMS Consensus Position on Part 15 Interference dated June 22, 1994; see also the Ex Parte Letter from Teletrac to the Chief, Private Radio Bureau, dated June 21, 1994.

<sup>86</sup> See 47 C.F.R. Section 15.247.

- (A) the antenna is 5 meters or less in height above ground; or
- (B) the antenna is more than 5 meters in height above ground but less than or equal to 15 meters in height above ground and either:
  - (i) adjusts its transmitter output power below 1 watt by  $20 \log(h/5)$  dB, where h is the height above ground of the antenna in meters; or
  - (ii) is providing the final link for communications of entities eligible under Subparts B or C of Part 90 of the rules.

Amateur operations in this band meeting these same parameters concerning antenna location, gain, and height as well as transmitter output power will also not be considered as sources of harmful interference. Conversely, Part 15 and Amateur operations not meeting these parameters and seriously degrading, obstructing or repeatedly interrupting the operation of a multilateration system, will be deemed to be causing harmful interference and, thus, upon Commission notification, be required to cease operations until the condition causing the interference has been corrected. We emphasize, however, that Part 15 or Amateur use is not restricted from operating beyond these parameters. Part 15 and Amateur operations can continue to operate as long as interference is not caused and are limited only by the technical parameters contained in the rules applicable to their respective services.

37. We agree with SBMS that the appropriate threshold for determining that Part 15 devices are presumptively not causing harmful interference to multilateration LMS systems is whether they are operating above 1 watt, because 1 watt "is approximately the level at which some current LMS devices transmit, and is well above most cordless phones and other personal Part 15 devices."<sup>87</sup> Under our rules, the transmitter output power of a Part 15 device is not permitted to be more than 1 watt. An antenna less than 5 meters in height driven by a transmitter with 1 watt or less of output power will only affect LMS operations that are relatively close. A higher antenna, however, has the capability to affect a larger number of LMS operations. This is why, between 5 and 15 meters, we adopt the stated formula to adjust the Part 15 transmitter output power. This assures that between 5 and 15 meters an outdoor antenna has the equivalent effect on multilateration LMS operations of a 5-meter antenna using no more than 1 watt transmitter output power. (We have not applied this sliding power reduction scale to devices directly serves public safety and special emergency eligibles so as to minimize the effect on communications involving the safety of life or property.) Height and transmitter power alone, however, are not the only components of a transmitted signal. The directional gain of the antenna also affects the radiated power, and thus the signal strength at the affected receiver. "If a 6 dBi antenna is used, pointing in the direction of the LMS site, then the received signal level, at the LMS site, will be 6 dB higher than if a 0 dBi antenna were used."<sup>88</sup> We conclude, therefore, that use of a Part 15 outdoor antenna with a directional gain of equal to or less than 6 dBi, or a Part 15 outdoor

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<sup>87</sup> Ex Parte Comments of SBMS dated August 12, 1994.

<sup>88</sup> Ex Parte Comments of MobileVision dated August 12, 1994, at Annex 1, page 4.

antenna with a directional gain of greater than 6 dBi having a proportional transmitter output power reduction, constitutes an appropriate threshold at which there is little likelihood of desensitization of the receiver(s) at an LMS site. Finally, because multilateration entities concur that most Part 15 interference to multilateration LMS systems is likely to be from field disturbance sensors and long range video links,<sup>89</sup> we will not make any presumption of interference-free operations for these devices when they operate in exclusive-use bands.

38. In view of the technical diversity of the many LMS systems in existence and the multiplicity of Part 15 devices that will eventually be placed in operation, we conclude that the above standards will not provide solutions to all interference problems, and this agency may not be able to resolve all interference problems that may arise between unlicensed Part 15 and LMS systems. As such, multilateration LMS systems that experience interference from an amateur or Part 15 transmission may face two different scenarios. Under the first scenario, where the interference is from an amateur or Part 15 system operating within the parameters set forth in paragraph 36, the interference is not considered to be harmful. The multilateration LMS system experiencing the interference has no recourse by way of complaint to the Commission. It may only attempt to resolve the interference by modifying its own system or by obtaining the voluntary cooperation of the amateur operator or Part 15 user. Under the second scenario, where the interference is from an amateur or Part 15 transmission that does not fall within the parameters set forth in paragraph 36, the multilateration LMS system experiencing the interference may have recourse by way of complaint to the Commission if voluntary measures fail to resolve an interference problem.<sup>90</sup> To assure that our limited resources are used efficiently and effectively, the complaint must identify the exact source of the interference. A Part 15 user that is causing harmful interference may resolve such a complaint by voluntarily adhering to the parameters stated above. Alternatively, the Part 15 user causing harmful interference may choose other courses of action, including: (1) reducing power sufficiently to avoid causing harmful interference; (2) lowering antenna height sufficiently to avoid causing harmful interference; (3) changing antenna directionalization to avoid causing harmful interference; (4) any combination of 1-3; (5) reaching an accord with the complaining LMS system; or (6) terminating operations. We do not envision readily solving all interference problems because of the technical diversity of the many LMS systems in existence and the multiplicity of Part 15 devices in operation, but believe that the vast majority of equipment and services can operate successfully in this band.

39. We believe that the procedures described above afford the best opportunities for amateur, Part 15 and multilateration LMS operations to coexist in the 902-928 MHz frequency band. Manufacturers of Part 15 devices whose equipment may cause harmful interference to multilateration systems may choose to restrict the operating frequency of their

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<sup>89</sup> See the LMS Consensus Position on Part 15 Interference dated June 22, 1994; see also the Ex Parte Letter from Teletrac to the Chief, Private Radio Bureau, dated June 21, 1994.

<sup>90</sup> See footnote 210 for a discussion of the nature of harmful interference to an LMS system.

devices to the 902-904 and 909.750-919.750 MHz sub-bands that will not be occupied by multilateration systems. Additionally, the 2400-2483.5 MHz band may prove to be useful to Part 15 operations that may not be accommodated successfully in the 902-928 MHz band (see discussions of the 2402-2417 MHz band in the Notice of Proposed Rulemaking in ET Docket 94-32).

#### **E. Spectrum Allocation Plan**

40. Currently, LMS systems can be licensed on a permanent basis at 904-912 and 918-926 MHz and on a developmental basis at 903-904 and 926-927 MHz.<sup>91</sup> In the Notice, we proposed that LMS systems be licensed on a permanent basis throughout the 902-928 MHz band, and that the band be divided into five sub-bands: 902-904, 904-912, 912-918, 918-926, 926-928 MHz.<sup>92</sup> We further proposed that multilateration systems be licensed in the 904-912 and 918-926 MHz sub-bands and that non-multilateration systems be licensed in the 902-904, 912-918, and 926-928 MHz sub-bands.<sup>93</sup>

41. Most entities providing or developing LMS systems support licensing LMS systems throughout the 902-928 MHz band.<sup>94</sup> Part 15 and amateur operators uniformly oppose our proposal to expand LMS use to all of the 902-928 MHz band. The Part 15 Coalition originally proposed that LMS systems be restricted to the existing two 8 megahertz bands and that each multilateration system be authorized for only 4 MHz each. Other commenters, such as NATA, DAC, and the Alarm Industry, propose that the total amount of spectrum for all LMS services be reduced to 8 MHz.<sup>95</sup> AT&T proposes that LMS systems be licensed only in the two 8 megahertz sub-bands currently allocated for LMS and that the rules be changed to eliminate multilateration systems, permitting only non-multilateration systems in the bands.<sup>96</sup>

42. Teletrac, MobileVision, Location Services, and SBMS support our proposal to

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<sup>91</sup> See Section 90.239 of the Rules, 47 C.F.R. § 90.239.

<sup>92</sup> Notice at para. 15, 8 FCC Rcd 2504 (1993).

<sup>93</sup> Id.

<sup>94</sup> See Teletrac comments at 20; MobileVision comments at 29-32; Mark IV comments at 6; Location Services comments at 4-5; AT/comm comments; Hughes comments at 6-7; Amtech comments at 2; Pinpoint comments at 2-3; and SBMS comments at 10.

<sup>95</sup> NATA comments at 12; DAC comments at 14; Alarm Industry comments at 9.

<sup>96</sup> Comments of AT&T.



create separate sub-bands for multilateration and non-multilateration systems.<sup>97</sup> Amtech and Pinpoint advocate shared use of the entire 902-928 MHz band by both multilateration and non-multilateration systems to maximize the capacity of multilateration systems and provide sufficient spectrum for non-multilateration systems requiring larger amounts of spectrum.<sup>98</sup> Texas Instruments/MFS proposes that multilateration systems be allocated only one 8 megahertz sub-band and that the rest of the band be available for non-multilateration use.<sup>99</sup> IVHS America and the DOT support our proposed division of the band, but would also permit multilateration and non-multilateration systems to have immediate access to each other's spectrum on a secondary basis and, after six years, would allow any unlicensed spectrum to be available for primary use by either multilateration or non-multilateration systems.<sup>100</sup> Mark IV and the Interagency Group would permit only electronic toll and traffic management (ETTM) systems to have access on an equal basis with multilateration systems on the proposed multilateration spectrum.<sup>101</sup> Several commenters have submitted studies to illustrate the difficulties that multilateration and non-multilateration systems would have in sharing the same spectrum.<sup>102</sup> Only two commenters, Amtech and Pinpoint, claim that such sharing is feasible and present a detailed sharing plan.<sup>103</sup>

43. In addition to requesting comment on the appropriate use of spectrum in the 902-928 MHz band for multilateration and non-multilateration LMS systems, we also made proposals and solicited comment on how multilateration systems, in particular, should be licensed. Specifically, we proposed that multilateration systems be licensed on a shared basis in the 904-912 and 918-926 MHz bands and that licensees be responsible for coordinating

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<sup>97</sup> See Teletrac comments at 20; MobileVision comments at 29; Location Services comments at 5; and SBMS comments at 10 [SBMS supports further dividing the sub-bands proposed for use by multilateration systems].

<sup>98</sup> Pinpoint comments at 9; Amtech comments at 7-14. Amtech, in its August 12, 1994 comments, indicates that "... at a minimum, the rules should accommodate the use of two 6 MHz channels for read-write tags." Comments at 2.

<sup>99</sup> Texas Instruments Incorporated/MFS Network Technologies, Inc. (TI/MFS) comments at 11-13.

<sup>100</sup> IVHS America comments at 20; DOT reply comments at 16-17.

<sup>101</sup> See Interagency group comments at 11-12; and Mark IV reply comments at 6-8.

<sup>102</sup> Teletrac comments at Appendix 2; MobileVision reply comments at appendix 3.

<sup>103</sup> See Amtech comments at 17-35; and Pinpoint comments at 9-39. Although Mark IV supports permitting co-equal access to spectrum for multilateration and at least ETTM non-multilateration systems, it does not provide a detailed sharing plan and does not evaluate the effects that non-multilateration systems would have on multilateration systems.